information, 1,693 of 1,761 U.S. television stations (96%) have made a DTV channel election. Of these 1,693, the vast majority (1,223 or 72%) elected a UHF channel, while 427 (25%) elected a high-band VHF channel and 43 (3%) elected a low-band VHF channel. Of the 43 stations electing a low-band channel, 28 are affiliates of the "big-four" networks, while 4 are affiliated with other networks, and 11 are non-commercial.

4. Predictive model

It appears that the predictive methodology presently used in the SHVA context (ILLR) has considerable applicability to the DTV world, but there remain improvements that might be made to properly accommodate reliable DTV reception. Some of these improvements are discussed below.

The FCC intends that DTV stations replicate their NTSC "Grade B" service areas. The Grade B F(50,50) service contours are based upon the assumption that an "acceptable" quality of service will be available at the best 50% of locations, 90% of the time.[33] Thus, to "replicate" coverage, the DTV signal also needs to produce an acceptable picture with50% situation reliability at least 90% of the time. Of course, in the case of NTSC, the difference between an acceptable picture and an unacceptable one might be an increase in the amount of snow; in DTV, the difference between an acceptable picture and an unacceptable one is no picture at all. So, the statistical parameters of the ILLR model should be set to the appropriate values. Presently, the ILLR model, as specified in OET Bulletin No. 72 for NTSC signals specifies that the time and situational variability factors are to both be set at 50%. We believe that for DTV, the appropriate factors would be 50% situation (confidence) variability[34] and 90–99% time variability, with the greater value being most prudent, at least until there is greater experience with consumer reception of DTV signals.

Factors for building penetration loss and use of an indoor antenna, as suggested elsewhere in this report could be incorporated into the ILLR model, when appropriate. A factor to account for ubiquitous antenna pointing errors is also appropriate for consumers having access to outdoor antennas.

Although a system noise figure has been assumed in the FCC planning factors for DTV receivers, that figure assumes a conjugate-impedance match between the receiver and antenna. In fact, a household antenna is rarely matched to the receiver.[35] Many of the antennas presently available for DTV have VSWR values that exceed 3:1 over much of their design bandwidth and exceed 2:1 over essentially all of

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[33] Robert A. O'Conner, "Understanding Television's Grade A and Grade B Service Contours," IEEE Trans. on Broadcasting, Vol. BC-14, No. 4, December 1968.

[34] When point-to-point mode is used, as in ILLR, there are well-defined paths with fixed terminals, so there is no location variability. There is still a "confidence" or "situation" variability factor of 50% that is sometimes called "location" variability, but the proper term is "situation" probability. See George Hufford, "The ITS Irregular Terrain Model, version 1.2.2: The Algorithm" for more information.

[35] Cozad, *op cit.*

their design bandwidth. The latter figure represents an increase in the effective system noise figure of 3 dB, which could also be incorporated into the model.[36]

5. Variability Among Consumer DTV Receivers.

Consumer DTV receiver designs continue to evolve. Five receivers (four consumer and one professional model) were evaluated for sensitivity for comparison with the FCC's planning factors, as follows:

1. LG LST-4200A
2. Samsung SIR-T451
3. Motorola HDT101
4. RCA DTC100
5. Zenith DTVDEMOD-S

Receivers 1, 2, and 3 were obtained from retail vendors in May 2005. Receiver 4 is an older model, purchased in 2000. Receiver 5 is a professional ATSC demodulator, which provides detailed information concerning equalizer performance, error rate, and other parameters.

The receivers were set up at a location (Alameda, California) having favorable path characteristics for DTV reception; that is, relatively constant signal levels, and multipath components having minimal amplitude and short delay. The receivers were connected to a common antenna and attenuation was added in 1 dB steps until visible failure of DTV reception occurred. The measurements show the differences in sensitivity of the receivers under favorable field conditions. The estimated margin of error for these measurements was ±1.5 dB.

	Measured Sensitivity by Channel, dBm						
Receiver	D12	D23	D29	D43	D41	D47	D49
1	-81.9	-82.6	-84.1	-80.4	-82.8	-81.1	-81.8
2	-80.9	-80.6	-83.1	-81.4	-80.8	-81.1	-82.8
3	-78.9	-83.6	-83.1	-83.4	-83.8	-82.1	-82.8
4	-75.9	-78.6	-82.1	-77.4	-77.8	-78.1	-78.8
5	-75.9	-78.6	-79.1	-79.4	-77.8	-79.1	-79.8
Variation in sensitivity RX1–4	6 dB	5 dB	2 dB	6 dB	6 dB	4 dB	4 dB
FCC PF	-81.2	-84.2	-84.2	-84.2	-84.2	-84.2	-84.2

The above results show that consumer receivers can differ in sensitivity by 2–6 dB under favorable field conditions. Laboratory tests (apparently at one channel) showed differences on the order of 0–3.4 dB without multipath and 0–8.7 dB in the presence of static multipath.[37,38]

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[36] Bendov, *op cit.*

[37] Charles Einolf, "DTV Receiver Performance in the Real World," Proc. NAB Broadcast Engineering Conference, 2000.

After compensating for the white noise enhancement of the equalizer (typically 0.2 dB), which was taken from Receiver 5 and assumed to apply to all of the other receivers, the sensitivities can also be compared with the FCC planning factor ("PF") values of -81.2 dBm at VHF and -84.2 dBm at UHF. Depending upon the channel involved, some receivers were up to 6.6 dB less sensitive than the planning factors specify. Considering all channels, the typical receiver was 2.6 dB less sensitive than the FCC planning factors.

6. Building Penetration Loss, Interference, and Clutter

Building penetration losses

Indoor receiving antennas, apart from having less gain than their outdoor counterparts, will typically be subject to weaker DTV signals. This is because the TV signal is attenuated as it passes through common building materials. The FCC conducted a measurement campaign, which found median building penetration losses of 30 dB at VHF and 26 dB at UHF for a number of buildings in the most "cluttered" parts of New York City.[39] In relatively less cluttered areas (boroughs outside of Manhattan), the measured building penetration losses were about 25 dB at VHF and 21 dB at UHF. Detailed information concerning the height of the receiving antenna (first floor, second floor, etc.) was not provided. A series of measurements conducted at UHF frequencies in the U.K. found building penetration losses in a six-story building of up to 16.4 dB at ground level, generally decreasing to about 2.5–4.2 dB at the sixth floor.[40] UHF frequencies tend to propagate into buildings better (that is, have less building penetration loss) than VHF frequencies because the dimensions of typical building openings (doors and windows) allow Fresnel clearance at the shorter UHF wavelengths. So, the building penetration losses at VHF television channels are expected to be greater.

The chart below, adopted from Parsons, shows a possible relationship at UHF between height in stories of the indoor receiving antenna and building penetration loss. For example, a viewer in a third-floor apartment having an indoor back-of-set antenna might be expected to experience a signal 10 dB weaker than an equivalent antenna outside the building. Note that in the United Kingdom, the ground floor is considered Floor zero, and the upper floors begin at one.

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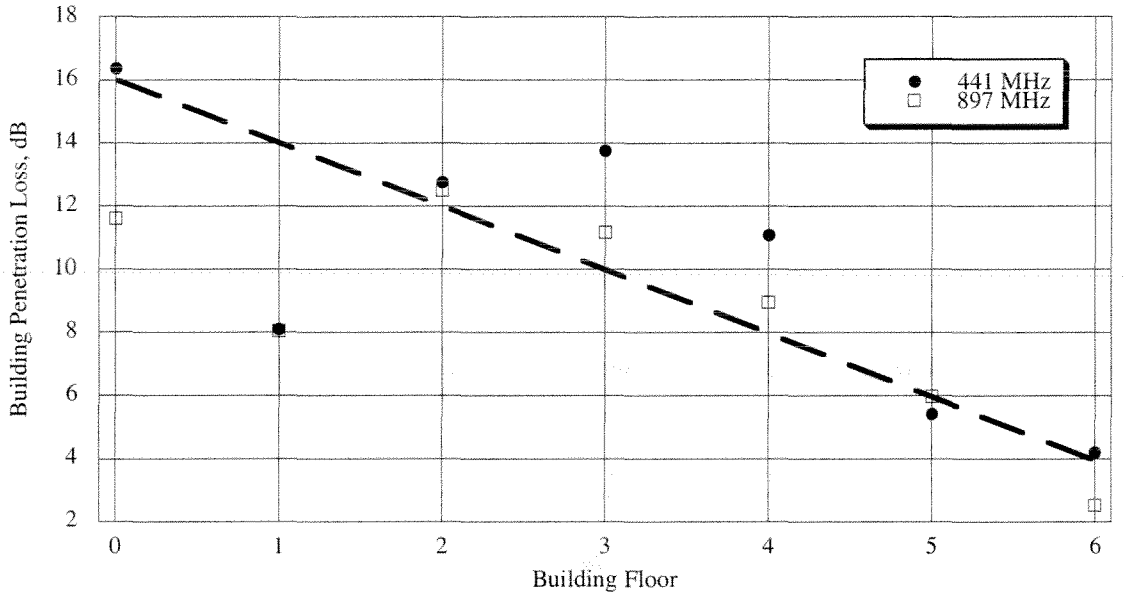
[38] Bernard Caron, *et al.*, "ATSC 8-VSB Receiver Performance Comparison," Proc. NAB Broadcast Engineering Conference, 2000.

[39] G.V. Waldo, "Report on the Analysis of Measurements: New York City UHF-TV Project," IEEE Trans. Broadcasting, Vol. BC-9, No. 2, 1963.

[40] J.D. Parsons, The Mobile Radio Propagation Channel,(West Sussex: John Wiley & Sons, 1992).



Interference from other signals

Several respected engineers have expressed concern about interference from adjacent-channel and intermodulation interference sources.[41][42] This firm is aware of several failures of DTV reception that are clearly attributable to so-called "image interference" from strong undesired signals. Image interference is not presently considered by the FCC in DTV-to-DTV station allocation. It appears, however, that there are presently insufficient data to assess typical consumer receiver performance in practical situations. This is because of the relatively small number of "full power" DTV stations presently on the air and the small installed base of consumer DTV receivers. With regard to co- and adjacent-channel interference, the existing protection ratios as documented in OET Bulletin No. 69 might be used presumptively to determine the presence of interference in both calculation and measurement. While these protection ratios are not based upon measurements of actual consumer DTV receivers, they can be expected to provide reasonable goals for DTV receiver designs.

Quantifying the circumstances under which current-generation DTV receivers cannot produce a picture when given adequate signal requires considerable data collection and time, and we are aware of no such

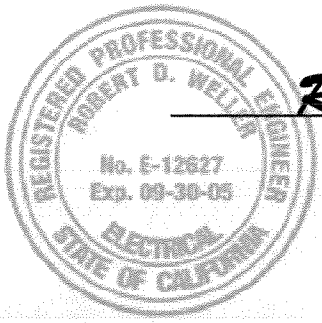
[41] Oded Bendov, "Interference to DTTV Reception by First Adjacent Channels," IEEE Trans. on Broadcasting, Vol. 51, No. 1, March 2005.

[42] Charles W. Rhodes, "Interference between Television Signals Due to Intermodulation in Receiver Front-Ends," IEEE Trans. on Broadcasting, Vol. 51, No. 1, March 2005.

efforts planned or underway. The absence of this critical data should *not* be used to imply that all reception issues have been resolved.

Clutter losses

As with NTSC signals, man-made and environmental clutter also effects DTV reception. Therefore, it remains important to include realistic clutter factors in the predictive model used for DTV.



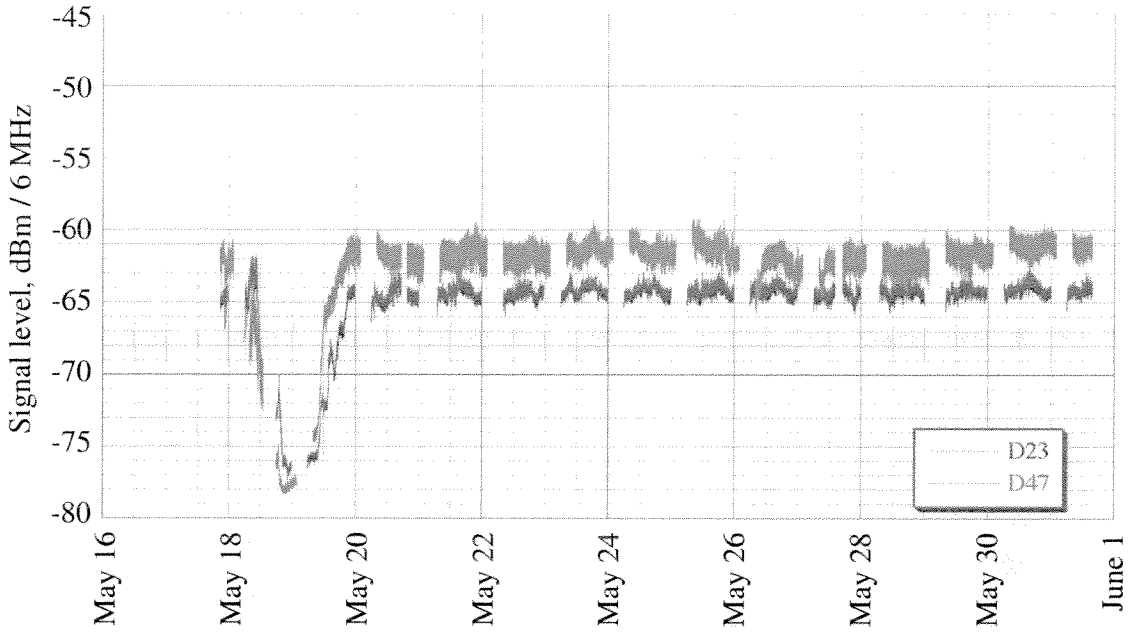
Robert D. Weller

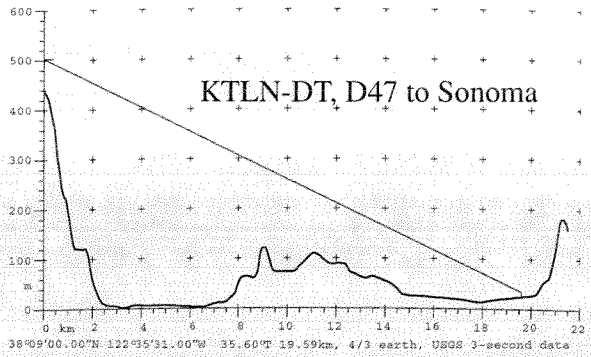
Robert D. Weller, P.E.

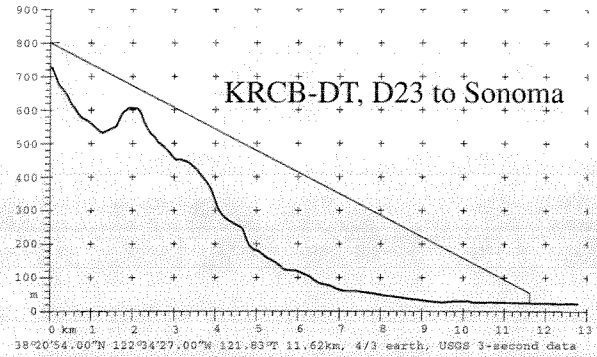
June 17, 2005

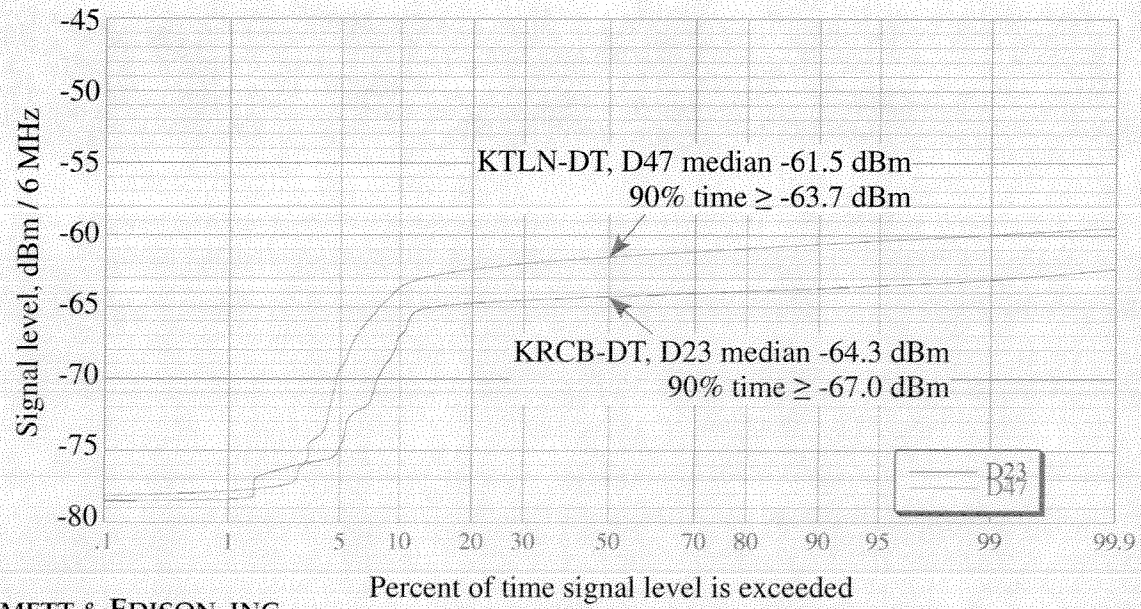
EchoStar Satellite, L.L.C. • Englewood, Colorado

Measured DTV Signal Levels – Short Line-of-Sight Paths







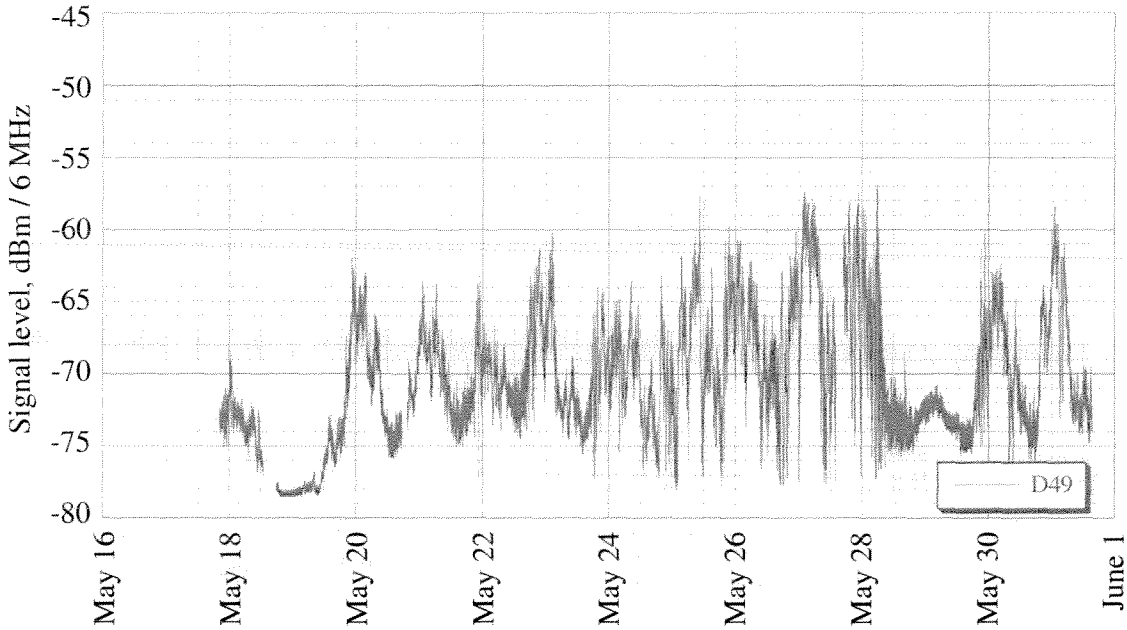


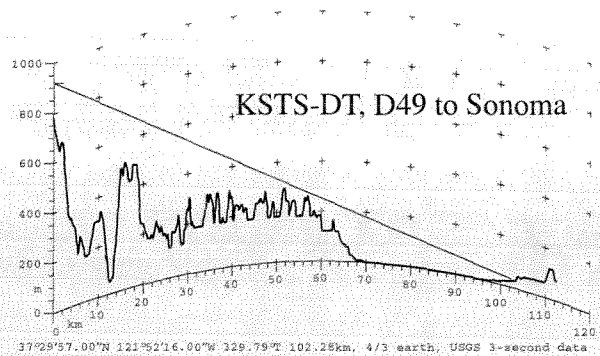
HAMMETT & EDISON, INC.
CONSULTING ENGINEERS
SAN FRANCISCO

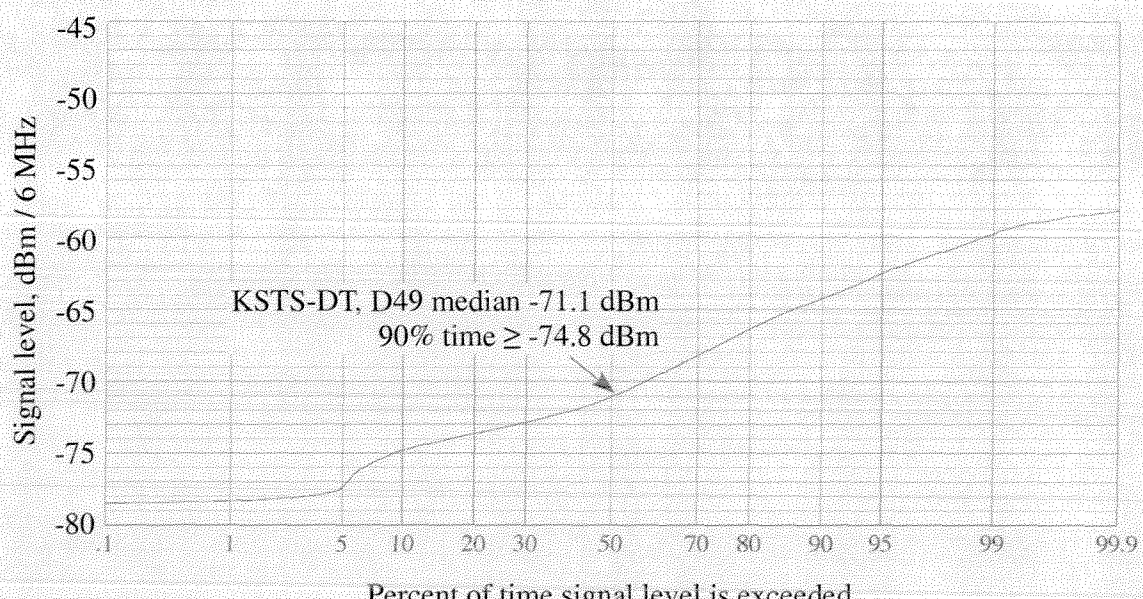
050617
Figure 1A

EchoStar EchoStar Satellite, L.L.C. • Englewood, Colorado

Measured DTV Signal Levels – Long Line-of-Sight Path





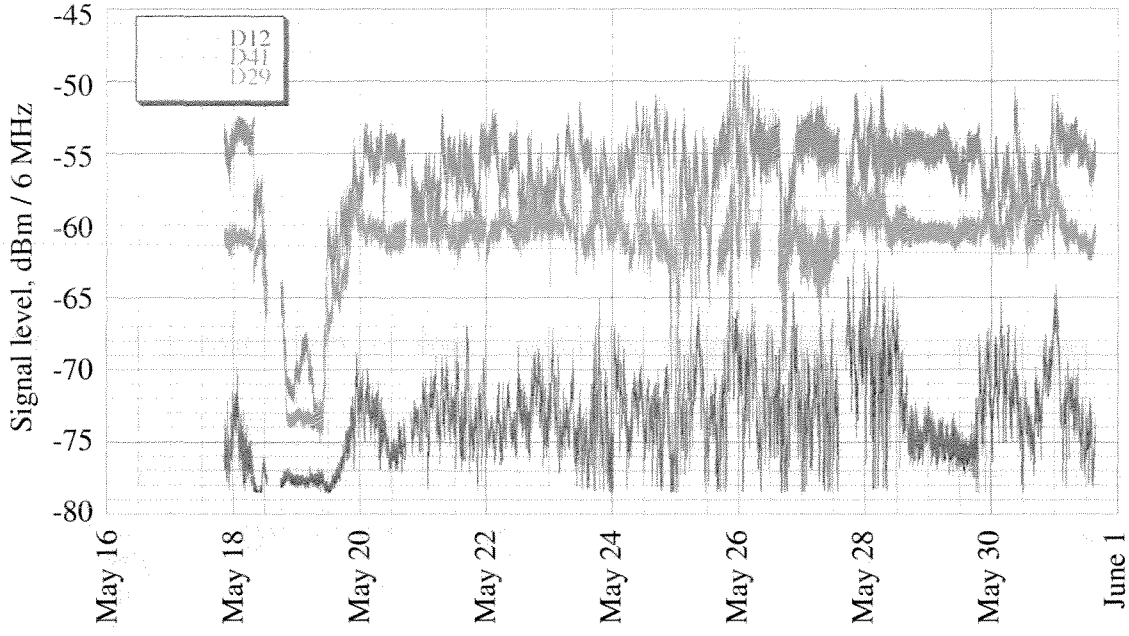


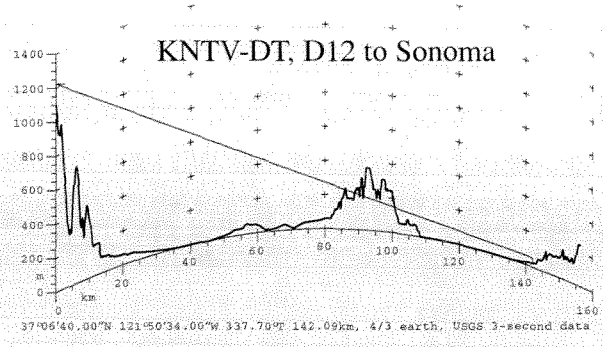
HAMMETT & EDISON, INC.
CONSULTING ENGINEERS
SAN FRANCISCO

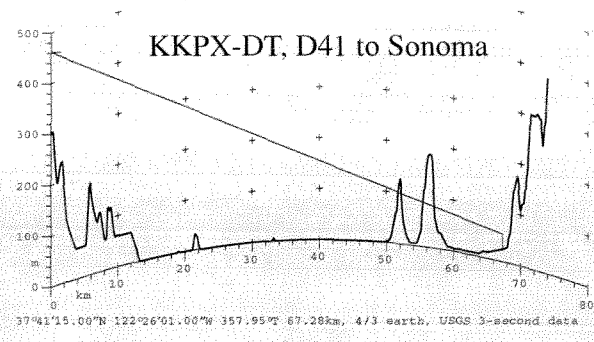
050617
Figure 1B

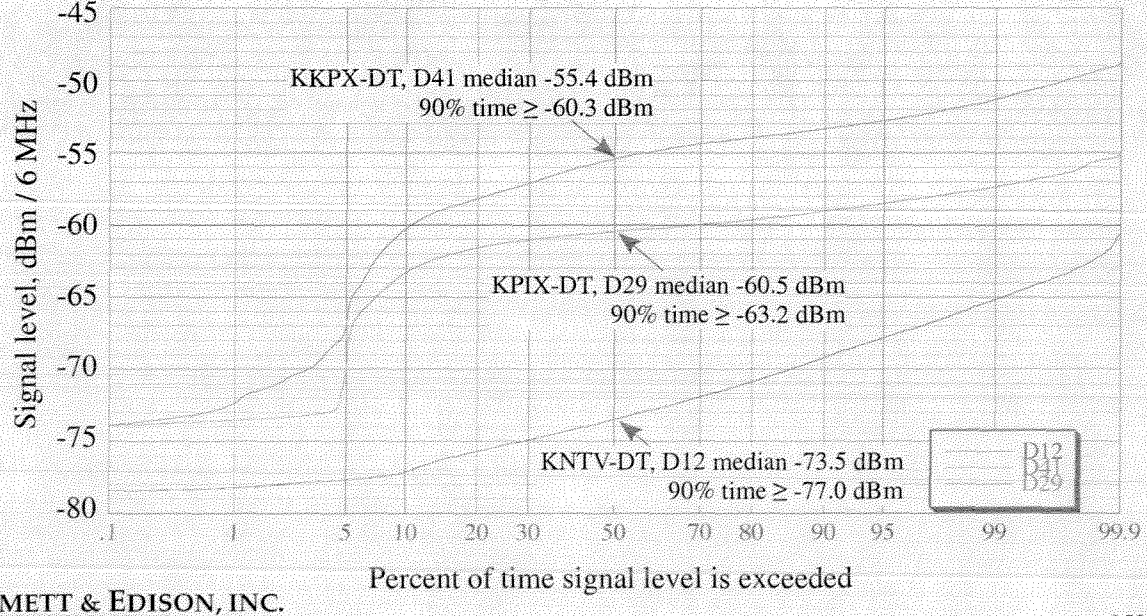
EchoStar EchoStar Satellite, L.L.C. • Englewood, Colorado

Measured DTV Signal Levels – Obstructed Paths









HAMMETT & EDISON, INC.
CONSULTING ENGINEERS
SAN FRANCISCO

050617
Figure 1C

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Technical Standards for Determining	)	
Eligibility For Satellite-Delivered Network	)	ET Docket No. 05-182
Pursuant To the Satellite Home Viewer	)	
Extension and Reauthorization Act	)	
Reauthorization Act of 2004	)	

REPLY COMMENTS OF ECHOSTAR SATELLITE L.L.C.

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July 5, 2005

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Technical Standards for Determining	)	
Eligibility For Satellite-Delivered Network	)	ET Docket No. 05-182
Pursuant To the Satellite Home Viewer	)	
Extension and Reauthorization Act	)	
Reauthorization Act of 2004	)	

REPLY COMMENTS OF ECHOSTAR SATELLITE L.L.C.

EchoStar Satellite L.L.C. ("EchoStar") hereby submits its reply comments on the Notice of Inquiry released by the Commission on May 3, 2005 ("NOI"). The NOI sought comment on the adequacy of the digital signal strength standard and testing procedures used to determine whether households are eligible to receive distant digital television ("DTV") network signals from satellite carriers.[1]

EchoStar urges the Commission to reject the often counter-intuitive submissions of broadcaster interests that would reduce the accuracy of digital signal strength testing and/or future predictive models in determining whether a consumer can actually receive a good quality digital picture over-the-air at his or her location using readily available consumer equipment. Such rules would doom millions of subscribers to inadequate DTV reception and delay the DTV transition that Congress has done so much to foster. If the DTV transition nonetheless proceeds,

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[1] *Technical Standards for Determining Eligibility For Satellite-Delivered Network Signals Pursuant to the Satellite Home Viewer Extension and Reauthorization Act*, FCC 05-94, Notice of Inquiry, ET Docket No. 05-182 (rel. May 3, 2005), published 70 Fed. Reg. 28503 (2005) ("NOI").

such proposals could mean that millions are left behind, without *any* high definition signal from one or more networks.

In addition, because the scope of the distant digital signal license is not the subject of this inquiry, the Commission should resist making premature pronouncements about the meaning of the statutory copyright license provisions, despite broadcasters' extensive submissions on this topic, and should focus instead on its statutory mandate to consider improvements to the digital signal strength standard and testing procedures. Finally, the Commission should dismiss, for being completely irrelevant to this proceeding, the gratuitous attacks made by broadcasters against the integrity of the Direct Broadcast Satellite ("DBS") industry.

I. THE COMMISSION SHOULD AVOID MAKING INTERPRETATIONS ABOUT THE SCOPE OF THE DISTANT DIGITAL LICENSE THAT ARE IRRELEVANT TO THIS PROCEEDING

As an initial matter, EchoStar notes that the National Association of Broadcasters ("NAB") and the ABC, CBS, and NBC Television Affiliate Associations ("Network Affiliates") devote many pages in their comments to setting out their interpretation of the general scope of the statutory license for distant digital signals, pointing to new limitations on the carriage of such signals introduced by the Satellite Home Viewer Extension and Reauthorization Act of 2004 ("SHVERA").[2] No doubt, the broadcasters would like the Commission to endorse its view of those provisions.

This inquiry, however, is not about the general scope of the distant digital signal license. Instead, this is "an inquiry regarding whether, for purposes of identifying if a household

[2] Comments of National Association of Broadcasters at 1-13, *filed in* MB Docket No. 05-182 (filed Jun. 17, 2005) ("NAB Comments"); Comments of the ABC, CBS, and NBC Television Affiliate Associations at 1-13, *filed in* MB Docket No. 05-182 (filed Jun. 17, 2005) ("Network Affiliates' Comments").

is unserved by an adequate digital signal under [17 U.S.C. § 119(d)(10)], the digital signal strength standard in [47 C.F.R. § 73.622(e)(1)], or the testing procedures in [47 C.F.R. § 73.686(d)], such statutes or regulations should be revised" to take into account various statutory factors affecting signal strength and reception.[3] To this end, the Commission is required to deliver a report to Congress with its recommendations for changes to the digital signal strength standard or testing procedures, including a recommendation on whether to use a predictive model to determine whether a household is "unserved."[4] This inquiry has nothing else to do with the digital signal license.

Accordingly, the broadcasters' extensive submissions in this regard are irrelevant and the Commission should resist making premature pronouncements about the meaning of the statutory license provisions beyond the scope of the inquiry mandated by Congress. Otherwise, the Commission risks making interpretive rulings in the abstract that parties may later claim were definitive and worthy of deference. Even more important, the Commission is not charged with enforcing the copyright laws. The courts, and not the Commission, are tasked with adjudicating disputes over the scope of 17 U.S.C. § 119.

II. THE COMMISSION SHOULD RECOMMEND CHANGES TO THE DIGITAL SIGNAL STRENGTH STANDARD, TESTING PROCEDURES AND FUTURE PREDICTIVE MODELS THAT WOULD IMPROVE, NOT WORSEN, THEIR ACCURACY IN DETERMINING WHETHER A HOUSEHOLD IS "UNSERVED"

Whether a household is unserved by a digital over-the-air signal should be measured against the consumer's ability to receive a good quality picture in the location in which he or she resides using readily available consumer equipment. The adequacy and accuracy of the

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[3] *See* 47 U.S.C. §§ 339(c)(1)(A) and (B).

[4] *See* 47 U.S.C. §§ 339(c)(1)(B)(iv) and 339(c)(1)(C).

digital signal standards, the testing procedures, and future predictive models should be judged against this standard.

As EchoStar has pointed out, digital television ("DTV") reception problems can result not only in degraded picture quality but, more often than with analog reception, can also result in the consumer not being able to receive a picture at all.[5] Consequently, it is important to ensure that the digital signal strength standard, the testing procedures, and any predictive model used to determine whether a household is unserved, take into account all factors that affect whether an artifact-free DTV *picture* can actually be received, and not merely whether the DTV *signal* is strong enough at the location in question. Contrary to the broadcasters' suggestion, the fact that Congress chose to limit the availability of distant digital signals in SHVERA does not reduce the need for accuracy in the remaining situations in which it is important to determine when a household is unserved. Indeed, these are the households most at risk during the digital transition -- *i.e.* households in smaller, typically rural, markets that cannot get a local digital signal over-the-air and in which cable service and/or satellite local-into-local service may not be available.

In its comments, EchoStar's engineering experts, Hammett & Edison, Inc. (H&E), have shown why some of the assumptions in the Commission's DTV planning factors appear to have been unrealistic. In a supplemental report (Attachment A), H&E further responds to the accuracy of the assumptions in the DTV planning factors raised by broadcasters ("H&E Reply Statement"). In addition, EchoStar has proposed several changes to the digital strength standard, testing procedures and predictive methodology that would make them more accurate in determining when a household is digitally "unserved," including the use of indoor antennas, the

[5] Comments of EchoStar Satellite L.L.C. at 2, *filed in* MB Docket No. 05-182 (filed Jun. 17, 2005) ("EchoStar Comments").

lack of rotation in many consumer antennas, and the need to take into account time variability in signal strength. In contrast, many of the broadcasters' comments and suggestions would have the opposite effect or impose unreasonable burdens on consumers.

The Broadcasters Ask Consumers to Make Unreasonable Expenditures to Gain Access to an High-Definition Signal. What is squarely *within* the scope of this inquiry is the extraordinary burden that the consumer would have to bear in order to satisfy all the requirements suggested by the broadcasting industry in order to receive a clear over-the-air digital signal. The broadcasters would have consumers purchase an incredible litany of state-of-the-art equipment, each straining further the consumer's budget: the most up-to-date "generation" of DTV receiver in order to reduce (without eliminating) multipath interference problems; a low-noise amplifier ("LNA") to boost DTV reception; Type RG-6 coaxial cable to avoid downlead line loss; separate antennas for VHF and UHF to improve reception; and some external means of switching between the two antennas. The cumulative cost of these items to consumers will be significantly above the cost of an analog-to-digital converter box that the broadcasters are urging Congress to provide as a subsidy for analog viewers. Finally, this enumeration of costs for additional items does not include any fees associated with installing these devices in consumers' homes.

The Commission's Planning Factors Were Intended Primarily For Channel Allotments. It is important to note that the DTV planning factors were developed primarily for a purpose different from that here. As H&E explains, these factors were adopted in part to assign channel allotments, and not for the more granular purpose of concretely ascertaining whether a particular consumer could actually receive a DTV picture at his or her home. Even more important, many of these factors have been overtaken by events.

For example, as H&E points out, the planning factors assume different receiving antenna patterns for analog and DTV reception.[6] The belief underlying that assumption was that consumers would install better-performing antennas for DTV use. In fact, however, events on the ground suggest a more reasonable assumption is that they will not. H&E notes that the specified 28 dBu minimum field strength required for DTV reception at VHF low-band has also been criticized as being inadequate,[7] largely due to inadequate consideration of man-made noise at those channels. Additionally, the planning factors assume that interference from DTV stations operating on other than co- and adjacent-channels would not exist. This assumption was in turn based upon the performance of a dual-conversion prototype DTV receiver. Again, subsequent developments have cast doubt on that assumption. Most of all, consumer DTV receivers today are single-conversion, meaning that they are far more susceptible to interference from so-called "taboo channels."[8]

Now that several generations of consumer DTV receivers are available, it is appropriate for the Commission to draw upon actual experience with this equipment to employ more empirically tested planning factors in this proceeding, since such factors will more accurately reflect the consumer's ability to actually receive a DTV picture.[9]

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[6] See H&E Reply Statement at 5 (citing H&E Petition for Reconsideration in MM Docket No. 87-268, filed June 13, 1997).

[7] *See id.* at 6 (citing Victor Tawil and Charles Einolf, Jr., "Impact of Impulse Noise on DTV Reception at Low VHF," Proc. IEEE Broadcast Technology Symposium, 2004).

[8] *Id.*

[9] In its Comments, EchoStar highlighted the results of an H&E study revealing that the signal sensitivities of the current generation of DTV receivers can be significantly worse than the signal sensitivities assumed in the Commission's planning factors. *See* EchoStar Comments at 4. H&E concluded that the digital strength standard should be revised upward to take into account the reality of DTV receiver sensitivity.

Use of Outdoor Antennas for Testing Would Lead to Many Inaccurate Determinations of When a Household is "Unserved." The NAB essentially concedes that "[i]ndoor antennas perform much less well at receiving over-the-air TV signals"[10] because they have lower gain, are typically located at lower heights than outdoor antennas, are nondirectional, and are prone to dynamic multipath problems that affect reception.[11] Counter-intuitively, however, the NAB's proposed solution is to continue digital signal strength testing using properly pointed roof-top antennas.[12] This would virtually guarantee an inaccurate determination of whether a household is unserved for the many (*e.g.* apartment dwellers) that cannot practically install directional rooftop antennas.

The fact that the Commission's DTV planning factors assume the use of rooftop antennas, raised by NAB as a justification for its position, is beside the point. The pertinent question here is not broadcasters' service area requirements. It is a simple and concrete inquiry: whether the consumer in question can actually receive a good quality digital picture over-the-air. Accordingly, the Commission should utilize actual, empirically-based planning factors in this proceeding, including use of indoor antennas. Equally unavailing is NAB's assertion that the viewers in question will also be utilizing a satellite dish, which is typically installed outdoors.[13] The fact that such residents will also need a properly pointed satellite dish does not justify use of outdoor antennas for testing. DBS antennas are typically smaller and need only be pointed in one direction, whereas outdoor DTV antennas typically require substantially more space and

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[10] NAB Comments at 16-17.

[11] *Id.* at 17.

[12] *Id.* at 16; *see also* Network Affiliates Comments at 34.

[13] *See* NAB Comments at 18.

may need to be rotated to adequately capture different over-the-air stations. As a result, a DBS antenna is practicable in many settings where a rooftop DTV antenna is not.

The Use of Directional Gain Antennas for Testing Has Already Been Correctly Rejected by the Commission. The Network Affiliates suggest that tests be conducted using a directional gain antenna as opposed to a half-wave dipole antenna.[14] This, they say, would "ameliorate any difficulties that could be caused by multipath at the site."[15] This suggestion is misguided, would likely lead to inaccurate results in determining whether a household is "unserved," and has for these reasons already been rejected by the Commission in the analog context. Directional gain antennas are not representative of most indoor antennas.

Moreover, directional gain antennas are more difficult to calibrate and are more easily damaged (leading to an uncalibrated condition). They are also more expensive. These shortcomings have already led the Commission to reject use of directional gain antennas for signal measurement under the Satellite Home Viewer Act:

> Regarding the preparation for measurements, we considered the kind of testing antenna that should be used and conclude that a tuned half-wave dipole is the best choice. It is widely available, inexpensive, and simple to use. In situations where definite readings are required, it has advantages over gain antennas that are difficult to characterize (calibrate) over a wide range of frequencies. Although dipole antennas are susceptible to interference from signals other than the one being measured, the cluster measurements that we require will mitigate those effects.[16]

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[14] Network Affiliates Comments at 38.

[15] *Id.*

[16] *See Satellite Delivery of Network Signals to Unserved Households for Purposes of the Satellite Home Viewer Act; Part 73 Definition and Measurement of Signals of Grade B Intensity*, 14 FCC Rcd 2654, at ¶ 51 (1999) (citations omitted).

"Fifth-Generation" And Later Receivers Are Not a Panacea for Dealing With Multipath Interference. The Network Affiliates' candid admission that there may be multipath problems sits uneasily with their position that "multipath should not be taken into account in determining whether a household is served by an adequate digital signal."[17] To arrive at this cavalier disregard of the problem, the Network Affiliates note that "fifth generation" or the "latest" receivers can deal with more types of multipath. The Commission should resist adopting that position. While the latest receiver designs do appear to have improved abilities to receive digital signals in the presence of certain types of multipath over prior generations, they do not represent a panacea. As H&E explains, the white noise enhancement penalty associated with the operation of the equalizer in the DTV receiver still remains and must be considered.[18] The presence of multipath at a receiving site effectively reduces the available strength of the DTV signal at that site because the equalizer in the receiver generates noise in proportion to the degree of multipath.[19] For example, if there is 3 dB of white noise enhancement, then a receiver that had a 15.2 dB noise threshold under ideal conditions (*i.e.*, no multipath) will have a 18.2 dB noise threshold under the multipath condition. This 3 dB increase in noise is equivalent to a halving of the transmitter power of the DTV station. The NAB presents data[20] showing that fifth generation receiver performance under some static multipath conditions requires 3–4 dB of additional signal to overcome the white noise penalty. Since white noise enhancement can be substantial at sites having severe multipath, it is important that this parameter be measured and subtracted from the nominal measured field strength in any field test.

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[17] Network Affiliates Comments at 37.

[18] H&E Reply Statement at 4.

[19] *Id.*

[20] NAB Comments at 41, Table 12.

Equally importantly, H&E explains that fifth generation designs generally have failed to address difficulties associated with producing a usable DTV picture under dynamic (as opposed to static) multipath conditions, which may account for the continuing failure to receive about 10% of signals under empirical conditions.[21] And H&E notes that improvements in the performance of the fifth-generation demodulators do nothing to improve the performance of other components in the DTV receiver. Specifically, the performance of the tuners in consumer DTV receivers has been criticized as limiting DTV reception in the presence of otherwise adequate signal levels.[22] While these DTV tuner problems are largely associated with the presence of strong interfering signals, there may be impacts at many locations on consumer reception of network signals, which will not be resolved by use of fifth generation receivers.

Finally, the Commission should keep in mind that consumers generally have no knowledge of what "generation" DTV receiver they are purchasing. The "generational" concept is one employed by consumer electronics manufacturers, and is not something publicized to consumers at large. Indeed, even engineering experts at times have difficulty ascertaining what "generation" a receiver might be, and manufacturers are not necessarily willing to supply such information.[23] Thus, consumers may be expected to seek the product having the lowest cost. They may often do so even if provided with detailed information concerning the performance characteristics of that product. For all of these reasons, the Commission should not rely upon the roll-out of fifth generation and later receivers as a substitute for coming to grips with known difficulties such as multipath.

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[21] H&E Reply Statement at 5 (citing Tim Laud, *et al.*, "Performance of 5th Generation 8-VSB Receivers," IEEE Trans. Consumer Electronics, Vol. 50, No. 4, November 2004).

[22] *Id.* (citing Charles W. Rhodes, "Interference Between Television Signals Due to Intermodulation in Receiver Front-ends," Proc. IEEE Broadcast Technology Symposium, 2004).

[23] *See id.*

The Commission Should Take Into Account the DTV Signal's Time Variability. As EchoStar explained in its Comments in this proceeding, the Commission should bear in mind that field measurements are no more than a "snapshot" of typical reception conditions and thus, are inadequate to ensure long-term reliability of DTV reception.[24] While DTV service is to have at least 90% reliability over time, a single a single set of cluster measurements cannot adequately characterize the time variability to provide reasonable assurance that the DTV signal will be available 90% of the time. Therefore, some additional action, such as applying a correction factor, must be done. This issue appears to have garnered little, if any, comment from other participants in this proceeding.

Given that the FCC's criterion for DTV coverage is a specified threshold field strength with 50% confidence, 90% of the time, that is, a situational variability factor of 50% and a time variability factor of 90%, commonly written as F(50,90), a 90% time (or greater) reliability factor should be applied to the assumed median value obtained during the cluster measurements to adjust the assumed "typical" measured field strength to a 90% time value.[25]

The Commission Should Not Assume That All Consumers Have Low-Noise Amplifiers. The broadcasters also suggest that it is reasonable to assume that consumers use low-noise amplifiers ("LNAs") mounted near their rooftop antennas to boost DTV reception.[26] This is a wholly unrealistic assumption for a number of reasons. First, most LNAs, however, are not suitable for use with indoor antennas.[27] Moreover, encouraging broader use of LNAs can

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[24] *See* EchoStar Comments at 8-9.

[25] *See* H&E Reply Statement at 6.

[26] NAB Comments at 22-23; Network Affiliates' Comments at 23-27.

[27] Low-noise amplifiers installed indoors are often ineffective because of the high radio frequency noise levels encountered in such environments. *See* http://www.tvantenna.com/support/tutorials/uhf.html (Presented by The National Association of

create serious unintended consequences. LNAs can make receiving installations prone to "overload" problems. That is, a strong nearby station (such as an FM broadcast station or amateur radio station) can overload the LNA, such that it does not function for reception of DTV signals. There is also a history of aging-related problems associated with LNAs, such that broader use should not be encouraged. Because they are installed outdoors and subject to many hot/cold cycles over time, many LNAs become unstable and self-oscillate -- basically becoming transmitters -- causing interference to various services, including public safety.[28] The FCC thus could create a significant new enforcement burden for itself by encouraging widespread consumer use of LNAs. Accordingly, tests should not be conducted using LNAs, nor should future predictive models for DTV reception assume that such amplifiers have been installed.

Land Cover and Land Clutter Values Should be Included in Predictive Models. As EchoStar has consistently pointed out, the ILLR does not, in fact, incorporate realistic values for land use and land clutter. This fact is borne out by a comparison between measured and predicted (using Longley-Rice) signal strengths conducted and reported by Anita Longley, *et al.* of the Institute for Telecommunications Sciences. As H&E explains, Ms. Longley reports that there are many cases when the results of the predictive model do not agree with the field measurements: "Some of the differences between predicted and measured median values may be caused by terrain clutter, such as buildings and trees, which has not yet been included in the

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Broadcasters, PBS, and Stallions Satellite and Antenna) ("This [preamplifier] unit should be mounted on the antenna mast about a foot below the main boom of the antenna...") *and* Network Affiliates Comments at Exhibit 1 (Antennacraft Pre-amplifiers are designed to be "mast-mounted;" Blonder-Tongue preamplifiers are designed to "mount on a 1.5 inch O.D. (max) antenna mast....").

[28] *See* Robert D. Weller, "Radio Frequency Interference from Non-Licensed Devices," RF Design, August 1992 (noting that about 6,800 reports of interference from non-licensed devices were found in the FCC's Case Management System database over the period October 1989-February 1992. A number of these reports were ultimately traced to radiating television pre-amplifiers).

prediction models."[29] Ms. Longley later added: "The [Longley-Rice] propagation model calculates transmission loss, with allowances for radio frequency, terrain irregularity, path length, and antenna elevation. Most of the data previously considered [in developing the model] were from open areas, towns and small cities. To this model, we can now add an allowance for the additional attenuation due to urban clutter...."[30] She then described a method for incorporating the effects of clutter, but this method is not incorporated into version 1.2.2 of the ITS Irregular Terrain Model, which underpins ILLR.

H&E observes that while it is possible that some of the data sets used in the development of the Longley-Rice model unavoidably contained clutter, clearly most did not, and the type or degree of such clutter, when present, was not systematically collected or included in the model. Even the Hufford paper cited by the Network Affiliates acknowledges this: "It should then be noted that these data [for the model] were obtained from measurements made with fairly clear foregrounds ... [i]n general, ground cover was sparse . . . ,"[31] which suggests careful site selection to minimize interference from clutter.[32] Indeed, Hufford advises users to "make suitable extra allowances or additions" when employing the model in "urban conditions" or other heavy land-cover situations.[33]

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[29] H&E Reply Statement at 1-2 (quoting A. G. Longley, "Measured and Predicted Long-Term Distributions of Tropospheric Transmission Loss," OT/TRER Report No. 16, July 1971, at 5) (internal quotation marks omitted).

[30] H&E Reply Statement at 2 (quoting A. G. Longley, "Radio Propagation in Urban Areas," OT Report 78-144, p. 31, April 1978).

[31] G.A. Hufford , "A Guide to the Use of the ITS Irregular Terrain Model in the Area prediction Mode," NTIA report 82-100, p.12, Apr. 1982, *quoted in* Network Affiliates Comments at 45.

[32] H&E Reply Statement at 1.

[33] Hufford, *supra*, at 12.

As every television viewer knows, buildings, trees, and other types of land clutter can interfere with a viewer's receipt of television transmissions. Accordingly, continued failure to account for the effects of land clutter in the ILLR model is simply wrong, and ensures that multitudes of consumers will be consigned to inadequate DTV signal reception.

Downlead Line Losses. The broadcasters attack the Commission's planning factors for downlead line losses as being too "conservative."[34] On the contrary, H&E has discovered a number of deficiencies in the Commission's downlead line loss factors. They lead to the conclusion that, if anything, the factors are inadequate. For example, the Network Affiliates erroneously infer, based upon review of one product from a single manufacturer, that Type RG-6 coaxial cable is subject to particular defined levels of loss lower than the Commission's planning factors.[35] H&E reports that in fact, this is not the case: as there are reports of material variation among the different RG-6 products made by various manufacturers, suggesting that the loss levels can in fact be higher than the planning factors.[36] Moreover, it is not necessarily realistic to assume that most consumers will even use RG-6 cable. Budget-conscious consumers will likely favor a less expensive alternative is available that is subject to even greater losses.[37] Finally, a number of other sources of loss, including "balun loss," "splitter" loss and losses due to "impedance mismatch," are not accounted for at all.[38] It follows that the Commission's planning factor values for downlead line losses, which account only for

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[34] Network Affiliates' Comments at 17.

[35] See Network Affiliates' Comments at 17.

[36] See H&E Reply Statement at 2.

[37] *Id.*

[38] *See id.* at 2-3.

cable losses, are inadequate and should be increased. Certainly, H&E's findings demonstrate that there is no basis for reducing downlead line loss factors, as the broadcasters suggest.

Use of Separate VHF and UHF Antennas. In determining the relevant figures for ascertaining the gain of typical consumer antennas, the broadcasters suggest the use of separate VHF and UHF antennas. Although, from a purely technical standpoint, the use of separate antennas for each band can result in improved receiving system performance, H&E reports that the use of separate antennas is atypical and unrealistic. The evidence is that consumers prefer combination antennas.[39] Not only do manufacturers appear to offer more combination antennas than VHF-only or UHF-only (doubtless a reflection of consumer preferences), but the added cost and technical complexities associated with separate antennas also make such a choice an unlikely one for consumers. Moreover, most, if not all, modern television receivers (including many of the most popular DTV receivers) lack the ability to switch between separate VHF and UHF antennas. This necessitates the installation of some external means of switching between the two antennas or combining in order to use separate antennas. This additional equipment adds to the cost and complexity of the receiving installation, and may be beyond the technical capability of some consumers.[40]

III. THE BROADCASTERS' GRATUITOUS ATTACKS ON THE INTEGRITY OF THE DBS INDUSTRY, AND ECHOSTAR IN PARTICULAR, ARE IRRELEVANT TO THIS INQUIRY

As noted above, this inquiry is about whether to make changes to the digital strength standards and testing procedures, and whether to introduce a predictive model, taking into account the statutory criteria spelled out in Section 339(c)(1) of the Communications Act.

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[39] *See id.* at 3-4.

[40] *See id.* at 4.